Requested Patent: GB995929A

Title: ;

Abstracted Patent: GB995929 ;

Publication Date: 1965-06-23 ;

Inventor(s): ;

Applicant(s): ;

Application Number: GB19620041174 19621031 ;

Priority Number(s): DE1961R031447 19611111; DE1962R032114 19620217 ;

IPC Classification: ;

Equivalents: AT239614B, CH404321, LU42402, NL138982B ;

ABSTRACT:

995,929. Valves. RHEINISCHE METALLWERK G.m.b.H. Oct. 31, 1962 [Nov. 11, 1961; Feb. 17, 1962], No. 41174/62. Heading F2V. A check valve has a movable closure member 11, Fig. 1, en- cased in an elastomeric material 12, e.g. rubber, which is integral with a bellows 14, the upper end of which is clamped to the valve casing; the bellows acts to load the closure member. The mem- ber 11 incorporates a stem 15 slidable in a hollow spindle 20 threaded into the casing and by which the valve may be voli- tionally closed. The lower part 5 of the material 12 may be grooved to form a sealing lip, and the convolutions of the bellows may be helical. The chambers above the closure member may be sealed so that the air in the chamber is com- pressed and exerts an additional closing force on the closure member as the latter lifts. In a modification, the closure member 11, Fig. 6, is arranged at an angle to the flow passage and a freely slidable sleeve 42 is dis- posed around the stem 15 to prevent the fluid in chamber 43 forcing the bellows 14 into con- tact with the stem 16; the sleeve 42 and stem 15 are made from a rust resistant material, or a synthetic plastic. In a further modification, the top of the closure member is provided with tongues which engage in body grooves to guide the closure member; these tongues also prevent the closure member from being urged too tightly on to its seat.

995,929

PATENT SPECIFICATION 995,929

DRAWINGS ATTACHED.

Date of Application and filing Complete Specification: Oct. 31, 1962. No. 41174/62.

Application made in Germany (No. R31447 XII/47g) on Nov. 11, 1961.

Application made in Germany (No. R32114 XII/47g) on Feb. 17, 1962.

Complete Specification Published: June 23, 1965.

Index at Acceptance:—F2 V(D11F, J2X, J4B, J4X).

Int. Cl.:—F 06 k.

COMPLETE SPECIFICATION.

An Improved Non-Return Valve.

We, RHEINISCHES METALLWERK G.m.b.H., of Porz near Cologne, Germany, a German Corporate Body, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to an improved non-return valve.

According to the invention we provide a non-return valve for controlling the flow of a fluid, in which a valve closure member has a resilient portion forming part of a resilient bellows hose, one end of which is sealed to a housing for the valve, the member being arranged to be urged away from a sealing position in which the resilient portion engages a seat when the fluid pressure in the intended direction of flow acting on the underside of the valve closure member exerts a force sufficient to overcome the restoring action of the bellows hose and the member being arranged to be urged towards the said sealing position by the restoring action of the bellows hose when the force of the bellows hose is greater than the force provided by the fluid pressure in the intended direction of flow of the fluid acting on the under-side of the valve closure member, and a guide shank is attached to the closure member and extends in the same direction as the direction in which the member moves towards and away from its seat.

A non-return valve exemplifying the invention is intended to operate so that when the pressure of a fluid in the inlet drops to below a specific value, the valve automatically closes. Thus, return flow of the fluid from the outlet to the inlet of the valve is substantially prevented.

The region enclosed by the bellows hose and the associated housing of the valve may be sealed off both from the external atmosphere and from the remainder of the interior of the valve so that a movement of the closure member towards its open position causes air in this region to be compressed. Thus, this pressurised air also assists in urging the closure member towards its closed position.

It has been found particularly convenient to give the bellows hose a screw-threaded profile over at least part of its length, and this screw-threaded profile may of a single-start type or a multi-start type.

In one embodiment of a valve exemplifying the invention a sleeve is arranged within the bellows hose to surround the shank. The length of this sleeve is approximately equal to the length of the bellows hose, and the sleeve is freely displaceable longitudinally along the shank. The sleeve and the shank can be made from a non-corroding material. Also the sleeve may be made from a synthetic plastic material. The inner diameter of the sleeve may be made slightly greater than the outer diameter of the shank.

The bellows hose acts as a spring which is compressed when the closure member is moved away from its seat and so energy is stored. The closure member remains in its open position so long as the force exerted upon it by the excess fluid pressure across the valve in the intended direction of flow of the fluid is greater than the spring force from the bellows hose urging the closure member towards its sealing position. The closure member is moved into its sealing position by the

spring force of the bellows hose as soon as the force exerted by the bellows hose becomes greater than the opposing force exerted by the fluid.

The guide shank is generally engaged in means for manually setting and maintaining the closure member in its sealing position.

Embodiments of non-return valves exemplifying the invention are illustrated, by way of example, in the accompanying drawings, in which:

Figure 1 is a vertical section through a non-return valve;

Figure 2 is a vertical section through a modified valve;

Figure 3 is a vertical section through another modified valve;

Figure 4 is a vertical section through a further modified valve;

Figure 5 is a perspective detail of the valve shown in Figure 4;

Figure 6 is a vertical section through a still further modified valve; and

Figure 7 is a section on the line 7—7 of Figure 6.

The non-return valves exemplifying the invention comprise a housing 10, a lightly tapering closure member 11 which is encased in a covering 12 consisting of rubber of other elastomeric material and a housing cover 18.

The covering 12 of the closure member 11 is continued so as to form a bellows hose 14, the free end of which is clamped between the housing 10 and the cover 18. The bellows hose 14 surrounds a shank 15 one end of which is connected fast to the closure member 11 and the other end of which engages in a hollow spindle 20 which is threaded by means of a screwthread 21 into the cover 18 and is movable to and fro in the cover 18 in the longitudinal direction of the spindle 20. The shank 15 in its turn is displaceable to and fro in the hollow spindle 20, the maximum amount of travel corresponding approximately to the amount of travel of the closure member 11.

As shown in the drawings fluid is arranged to flow in the direction of the arrow 25 through an inlet 26 and provides a pressure against the underside 27 of the closure member 11 so as to displace this member from the position shown in the drawings and to compress the bellows hose 14 in a direction towards the spindle 20. The displacement of the closure member also causes the shank 15 to be displaced until its free end 28 abuts against the inside end 29 of the hollow spindle 20. Then the closure member 11 is in its open position and fluid is able to pass from the inlet 26 through an outlet 30.

As soon as the pressure in the pipeline falls below a specific value, the closure member 11 is again urged back into the position shown in the drawings owing to the resilient force of the bellows hose 14. Thus, the closure member 11 will again close the inlet 26 when the force acting on the closure member 11 which is caused by the pressure of the fluid acting on the surface 27, becomes less than the force exerted by the loaded bellows hose 14 in the opposite direction.

The valve may also be closed independently of the pressure prevailing in the inlet 26 by actuating the spindle 20. Thus to close the valve, the spindle 20 is screwed into the housing cover 18 so that the end surface 29 of the spindle 20 is pressed against the free end 28 of the shank 15 and the closure member 11 is forced into the closed position. Then the closure member 11 can no longer be moved out of its closed position into its open position by pressure exerted on the surface 27.

All the embodiments illustrated in the drawings have the fundamental construction and operation just described. Thus, although the inlet 26 and the outlet 30 can be arranged in many different ways, and as shown in the embodiments of Figures 1, 2 and 4, the closure member 11 can be displaceable to and fro in a vertical direction or, as shown in Figures 3 and 6, the closure member 11 can be displaceable at an acute angle to the main direction of throughflow 25, when the spindle 20 is opened the closure member 11 is displaceable under the influence of the pressure of the fluid into an open position in all the embodiments. When the pressure of the fluid drops below a specific, adjustable value, the bellows hose 14 which acts as a spring uses the energy stored up in it during the opening operation of the member 11 in order to displace the member 11 into its closed position. Thus, when the valve is opened by the pressure of the fluid, the spring force of the bellows hose must be overcome and in this operation potential energy is at the same time stored up in the hose to be utilised later so as to close the valve when the pressure of the fluid decreases.

In the embodiment shown in Figures 4 and 5, the bellows hose 14 is profiled in the manner of a screwthread. This enables the spring force of the hose 14 to be considerably increased, and since it will be readily apparent from the fact that a bellows hose as shown in Figures 4 and 5 is constructed in the manner of a coil spring. The potential energy stored up in such a bellows hose upon opening of the closure member 11 is sufficient even under difficult conditions to press the closure member 11 into a satisfactory sealing-tight position in its seating when the medium pressure falls below a specific value. The

sealing-tightness which can generally be obtained is so great that the quantity of fluid which can flow back from the outlet 30 into the inlet 25 before the closure member 11 shuts off the inlet from the outlet is far below the maximum quantity generally considered as permissible.

In order to influence the spring force and other properties of the bellows hose 14, it is possible, for example, for multi-start screwthread profile to be given to the hose, or for the pitch of the screwthread to be varied.

In the embodiment shown in Figures 6 and 7, the shank 15 of the closure member 11 is surrounded by a sleeve 42 the length of which corresponds approximately to that of the bellows hose 14. This sleeve 42 is free to move relatively to the shank 15 and to the bellows hose 14 in the longitudinal direction of these parts. When in the wholly or partly open state of the valve the fluid acts on or fills a chamber 43 through which the bellows hose 14 extend, it is possible for the bellows to be pressed radially inwards in the direction towards the shank 15 until the inside face of the bellows hose abuts against the sleeve 42. If the sleeve 42 were not present the bellows hose 14 would abut against the shank 15.

In the embodiment shown in Figures 6 and 7, the diameter of the bellows hose 14 is so dimensioned that its inner folds 14*a* just contact the sleeve 42. The arrangement may, of course, also be such that the bellows hose 14 remains with its inner folds 14*a* slightly spaced from the shank 15 or sleeve 42 when the fluid is not acting upon it or is only slightly acting upon it. In both cases, when the valve is opened the pressure of the fluid in the chamber 43 may be so great that the bellows hose 14 is pressed very strongly against the sleeve 42 so that, if the latter were connected rigidly to the shank 15, considerable friction would occur upon movement of the bellows hose 14 relatively to the sleeve 42 or shank 15. In this way the bellows hose might become correspondingly stressed and worn. The bellows hose, particularly if the friction between it and the shank 15 or sleeve 42 varies over its length, might also become irregularly folded upon opening of the valve and this might also lead to the destruction, or at least to the fatigue, of the material. These disadvantages are substantially avoided by surrounding the shank 15 by the sleeve 42 which, when the bellows hose 14 is pressed against it, is entrained upwards by the hose during the opening movement, i.e. towards the right as shown in Figure 6.

The friction between the sleeve 42 and shank 15 is very low so that it need not be considered for practical purposes. A certain relative displacement also occurs between bellows hose 14 and the sleeve 42 during the opening and the closing of the valve. This is readily apparent since the hose 14 varies its length during an opening or closing operation, whereas the length of the sleeve 42 remains the same. The frictional forces occurring between bellows hose 14 and the sleeve 42 are, however, slightly less than the force which would occur between hose 14 and shank 15 if the sleeve 42 were not provided. This may be ascribed to the fact that, owing to the longitudinal displaceabilty of the sleeve 42 along the shank 15, the extent of the relative displacement between this and the hose 14 is less than between the hose 14 and shank 15. Also the sleeve 42 can be made of such a material or its surface can be so treated that the friction between it and the hose 14 is reduced to a minimum. In order to further improve the frictional conditions between the sleeve 42 and the shank 15, and between the sleeve 42 and the hose 14 on the other hand, the sleeve and the shank may be made from a non-corroding material, for example a rust resistant metal. Also the sleeve may be made from a hardened synthetic plastic material. In general, the sleeve 42 is made from a material which has a favourable influence on the friction between sleeve and bellows hose. Since the sleeve 42 is not subjected to any stresses, the material of the sleeve can be selected simply in accordance with the above factors. The inner diameter of the sleeve 42 may be slightly greater than the outer diameter of the shank 15. Thus, since the bellows hose 14 is acted upon by a similar pressure all round, in some circumstances the sleeve is displaced centrally about the shank 15 without contacting it.

In the embodiment of Figures 6 and 7 the closure member 11 may be conical, as is the embodiment of Figure 1, and it is also readily possible for the closure member 11 and the spindle 20 to be arranged that they extend substantially at right angles to the inlet 26. However these embodiments could still contain a sleeve 42.

In the embodiments shown in Figures 3 to 7 the covering 12 of elastomeric material surrounds the closure member 11, and a groove 35 is provided in the covering 12, the groove co-operating with the housing seat when the member 11 is in the closed position. This groove 35 forms a sealing lip 36 which encircles the member 11 completely. This sealing lip 36 may project slightly beyond the outer periphery of the closure member 11 in the non-deformed or non-stressed state when the member 11 is pressed into its seat. That is to say, in the closed position of the closure member 11

the lip 36 bears against the seat 11*b* as shown in Figure 6. Thus, the sealing effect of the closure member is improved by the lip 36. In addition, the fluid in the outlet 30 of the valve also presses against the boundary of the groove 35 and therefore forces the lip 36 against the seat 11*b*.

It will, naturally, depend on the particular purpose for which the valve is designed as to whether the constructional form according to Figures 1 and 2 or the form according to Figures 3 to 7 is chosen. Generally, however, the arrangement of the groove 35 and the sealing lip 36 will improve the sealing-tightness of the closure member 11.

In the embodiment shown in Figures 4 and 5 the closure member 11 comprises near its end adjacent the bellows hose 14 an encircling collar 40 on which are mounted two diametrically opposed metallic dogs or tongues. These dogs or tongues engage in corresponding grooves in the housing 10 and thus satisfactorily guide the closure member 11. The collar 40 engages in an appropriate recess 41 in the seat for the closure member 11. The collar 40 is intended to prevent the member 11 from being clamped too tightly in its seat since it would otherwise be possible that the force exerted on the surface 27 by the fluid pressure would not be sufficient to overcome the friction between member 11 and its seat. Thus, the member 11 could not be forced into the open position by the fluid pressure.

The provision of the collar 40, which of course could also be replaced by individual abutments or the like, ensures that it is not possible to force the closure member 11 into its seat to beyond a certain extent, and this limit is also chosen so that satisfactory sealing-tightness is achieved when the valve is closed. The collar 40 may also be provided with a covering of an elastomeric material.

It will be apparent that a collar 40 may also be provided in the embodiments of Figures 1, 2 and 3. In the case of the embodiment shown in Figures 6 and 7, the closure member 11 is constructed so that it has at its end nearest the bellows hose 14 a part of relatively large diameter which co-operates in the closed position of the valve with an abutment in the housing 10 see Figure 6.

In the embodiments shown in Figures 1 and 2, a sealing ring 24 is arranged around the lower end of the spindle 20 so as to seal off the spindle 20 relatively to the cover 18. The space which is enclosed by the closure member 11, bellows hose 14, cover 18, spindle 20 and sealing element 24 is filled with air and this space is compressed when the closure member 11 is displaced from the closed position shown in Figures 1 and 2 into the open position. Thus, this enclosed air also exerts a closing force on the closed member 11 when the valve is in the open position, and this air pressure in the enclosed space contributes to shifting the closure member 11 into its closed position when the pressure of the fluid in the inlet 26 drops below the particular level.

In the embodiment shown in Figures 4 to 7 no sealing ring 24 is provided so that the air space enclosed by the bellows hose 14 is in communication with the outside atmosphere. It depends on the given operating conditions and circumstances of the valve which of the two constructional forms will be selected in an individual case.

WHAT WE CLAIM IS:

1. A non-return valve for controlling the flow of a fluid, in which a valve closure member has a resilient portion forming part of a resilient bellows hose, one end of which is sealed to a housing for the valve, the member being arranged to be urged away from a sealing position in which the resilient portion engages a seat when the fluid pressure in the intended direction of flow acting on the under-side of the valve closure member exerts a force sufficient to overcome the restoring action of the bellows hose and the member being arranged to be urged towards the said sealing position by the restoring action of the bellows hose when the force of the bellows hose is greater than the force provided by the fluid pressure in the intended direction of flow of the fluid acting on the under-side of the valve closure member, and a guide shank is attached to the closure member and extends in the same direction as the direction in which the member moves towards and away from its seat.

2. A valve as claimed in Claim 1, in which means are provided for manually setting and maintaining the valve closure member in its sealing position.

3. A valve as claimed in Claim 1 or Claim 2, in which the closure member is provided with a stop member which is arranged to abut a projection on the housing so as to limit the amount to which the closure member is able to be urged against its seat when in its closed position.

4. A valve as claimed in any of Claims 1 to 3, in which the resilient portion forms a covering layer for the closure member, and the portion and the bellows hose have been formed from an elastomeric material.

5. A valve as claimed in claim 4, in which the covering layer has a groove providing a sealing lip cooperating with the seat in the sealing position of the closure member.

6. A valve as claimed in any of the

preceding claims, in which the region enclosed by the bellows hose is sealed both from the external atmosphere and from the remainder of the interior of the valve.

7. A valve as claimed in any of the preceding claims, in which the bellows hose has a screwthread profile over at least part of its length.

8. A valve as claimed in any of claims 1 to 6, in which the bellows hose has a multi-start screw thread profile over at least part of its length.

9. A valve as claimed in any of the preceding claims, in which the guide shank is surrounded by a sleeve within the bellows hose, which sleeve is freely displaceable along the length of the shank, and the length of the sleeve being approximately equal to the length of the bellows hose.

10. A valve as claimed in claim 9, in which the sleeve has been made from a non-corrosive material.

11. A valve as claimed in claim 9, in which the sleeve has been made from a synthetic plastic material.

12. A valve as claimed in any of claims 9 to 11, in which the guide shank has been made from a non-corrosive material.

13. A valve as claimed in any of claims 9 to 12, in which the inner diameter of the sleeve is slightly greater than the outer diameter of the guide shank.

14. A non-return valve for controlling the flow of a fluid substantially as hereinbefore described with reference to Figure 1, or Figure 2, or to Figure 3, or to Figures 4 and 5, or to Figures 6 and 7, of the accompanying drawings.

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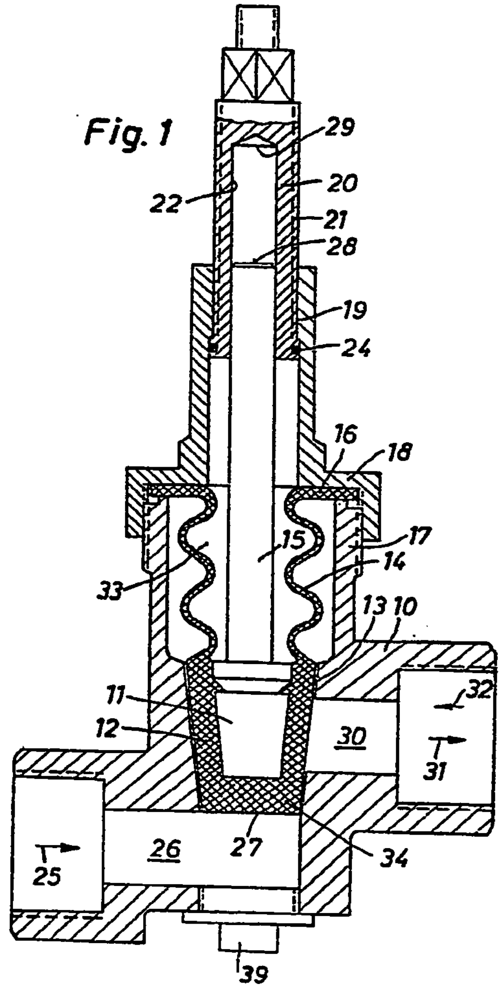
Abingdon: Printed for Her Majesty's Stationery Office, by Burgess & Son (Abingdon), Ltd.—1965.
Published at The Patent Office, 25 Southampton Buildings, London, W.C.2,
from which copies may be obtained.

Fig. 1



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995929 COMPLETE SPECIFICATION

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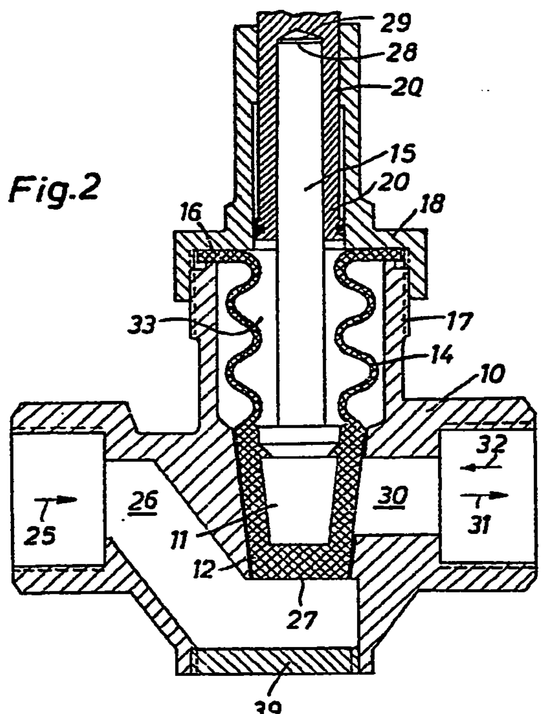
Sheets 1 & 2

Fig.2



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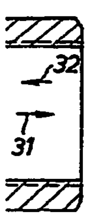


Fig.3

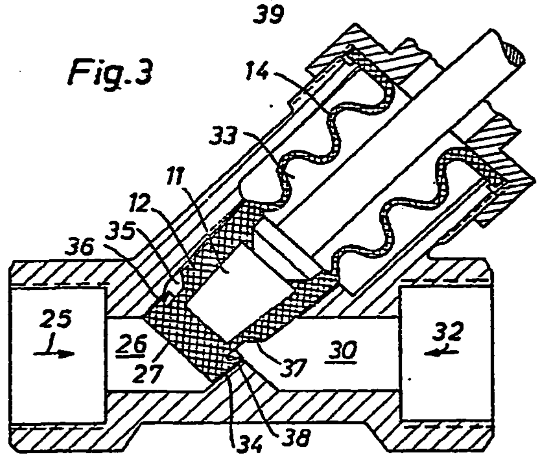


Fig.1

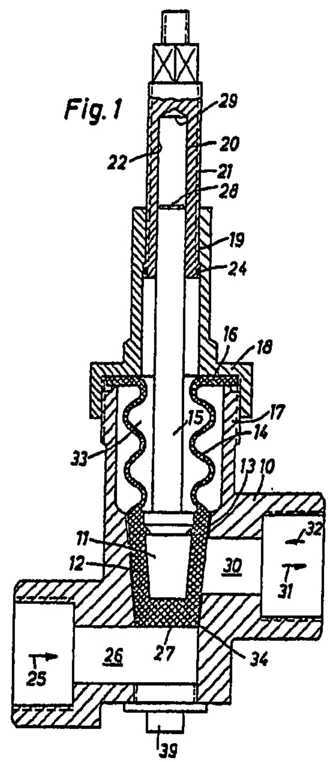


Fig.2

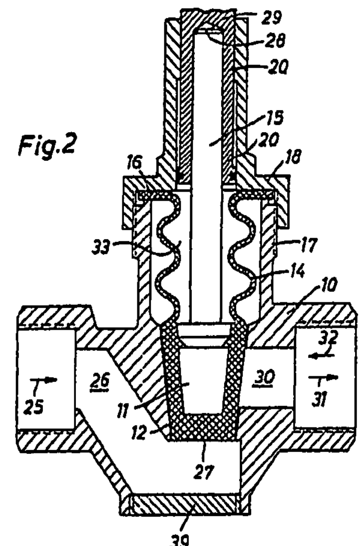
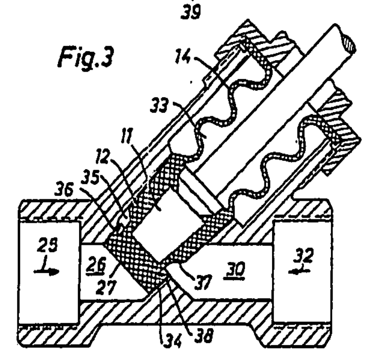


Fig.3



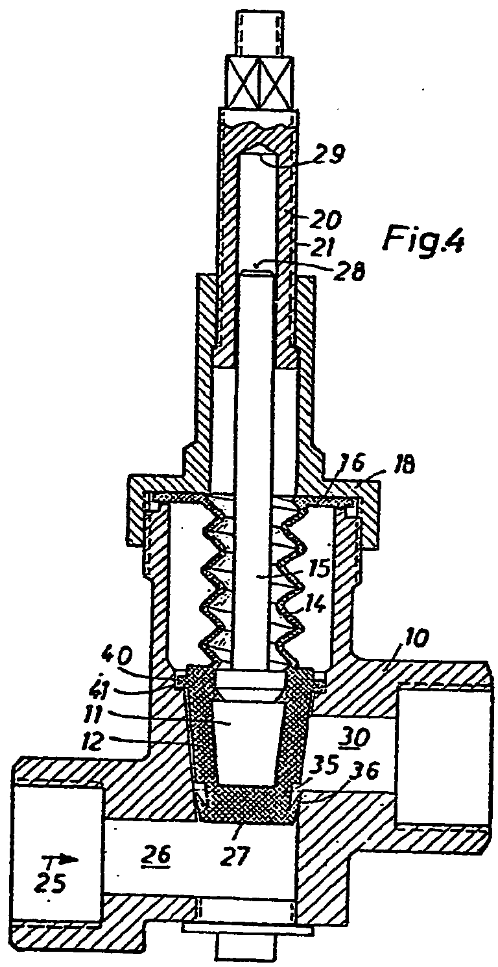

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Fig.4

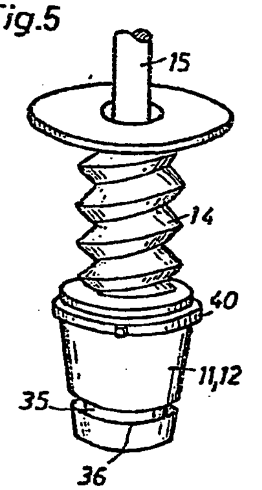
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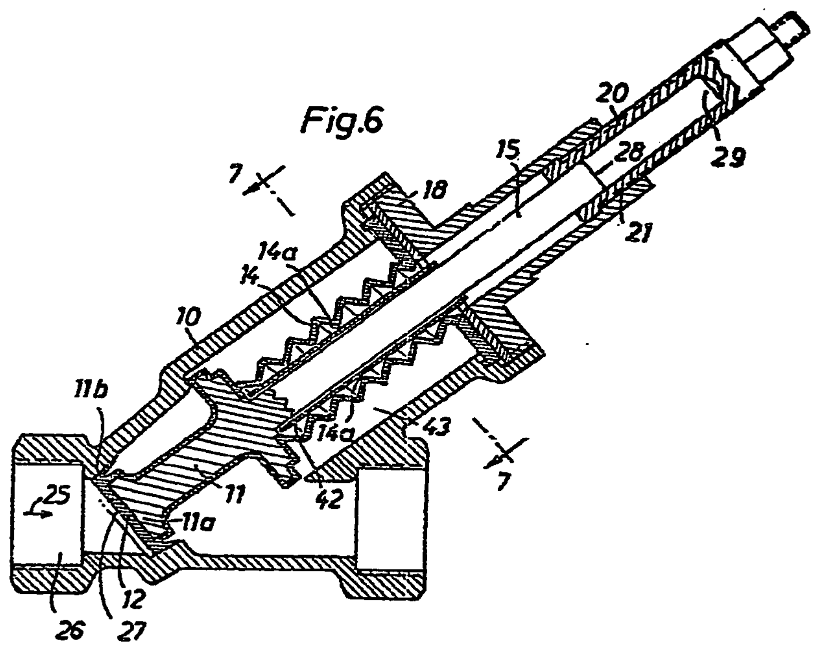
Fig.5

995929 COMPLETE SPECIFICATION
4 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheets 3 & 4

Fig.6



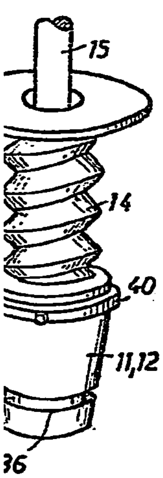
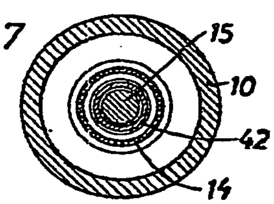


Fig.7



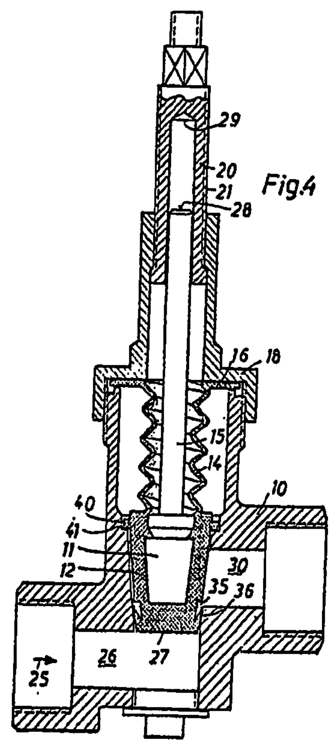


Fig.4

Fig.5

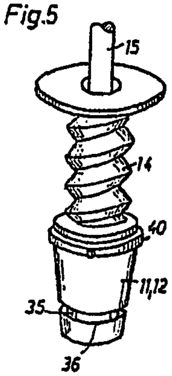


Fig.6

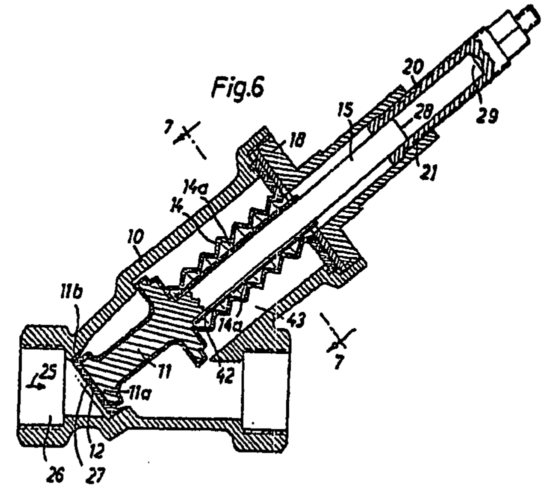


Fig.7